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A Survey of Free Math Fonts for TEX and LATEX

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Abstract We survey free math fonts for TEX and LATEX, with examples, instructions for using LATEX packages for changing fonts, and links to sources for the fonts and packages.

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1 Introduction

One of the biggest challenges in selecting a font for TEX or LATEX is that there are not very many math fonts that match the plethora of available text fonts. It's reasonably easy to use an arbitrary Postscript Type 1 font in TEX for text (see Philipp Lehman's Font Installation Guide [1]), but obtaining and configuring a matching math font from scratch is a demanding task. Thus, there are few math fonts for TEX, and in particular very few free ones. However, in the past few years, several very nice free fonts have been released. The goal of this article is to list all of the free math fonts and to provide examples.

"Free" here means fonts that are free to use (both commercially and non-commercially) and free to distribute, but not necessarily free to modify. I also am biased towards listing fonts that have outline versions in PostScript Type 1 format suitable for embedding in Postscript PS or Adobe Acrobat PDF files. Donald E. Knuth originally designed the METAFONT system for producing fonts for TEX in bitmap format. PS or PDF files that have embedded bitmap fonts do not display well in Adobe Acrobat Reader,[1] to the point of being almost unreadable on the screen, and are also noticeable when printing at extremely high resolutions (on photo-setters, for instance). Since outline fonts contain mathematical descriptions of the curves used in each glyph, they can be scaled to any resolution while retaining image quality.

The fonts listed here are categorized according to their origin: whether originally designed for TEX, related to the standard Postscript fonts, or other free fonts. A font's origin does not particularly bear on its quality or suitability for typesetting mathematics. No recommendations or evaluations of the fonts are given here, as people's tastes in fonts vary greatly. The goal of this survey is simply to make authors aware of all their options.

Most of the fonts can be selected by including a single package in the preamble of the user's LATEX file (the *preamble* is the section after "`\documentclass{}`" and before "`\begin{document}`"). The line or lines to include for each font are listed in the caption of the sample figure. For example "`\usepackage{fourier}`" uses Utopia and Fourier-GUTenberg, as shown in the sample LATEX file in Section 6.

Walter A. Schmidt also has a survey in German of math fonts [3] that con-

1. Starting with version 6, Adobe Acrobat Reader displays bitmap fonts fine. The free PDF viewers Ghostview and xpdf have always displayed bitmap fonts accurately.

centrates more on commercial fonts. Schmidt's survey has several examples that show different pairings between text fonts and math fonts.

2 Fonts Originally Designed for TEX

These fonts were originally designed for use with TEX, using either METAFONT or MetaType1 [2].

Computer Modern: Knuth created Computer Modern [5] as the default font for TEX. The font set includes serif, sans serif, and monospaced text faces, and corresponding math fonts. The math symbol set is very complete. Computer Modern is *the* font for TEX, which leads some to claim that the font is overused. The characters are fairly thin and light, and so are not as readable on screen in small sizes or from high-resolution laser printers.[2] In a comparison by Raph Levien, the printing in Knuth's *Digital Typography* [7] is heavier than the digital version or from a laser printer.

Type 1 versions of Computer Modern from Blue Sky Research and Y&Y, Inc. have been made freely available by the American Mathematical Society (AMS) and a collection of publishers and other technical companies [8,4]. Basil K. Malyshev has also released a free Type 1 version of Computer Modern [9], originally for use with his TEX system BaKoMa TEX.

Computer Modern has been extended to include more characters, particularly for non-English European languages. These fonts include European Computer Modern by Jörg Knappen and Norbert Schwarz (METAFONT only) [10]; Tt2001 by Szabó Péter (converted into Type 1 format from METAFONT sources using `textrace`; Tt2001 has been superseded by CM-Super, which Péter recommends) [12,11]; CM-Super by Vladimir Volovich (also converted using `textrace`) [14,13]; and Latin Modern by Bogusław Jackowski and Janusz M. Nowacki (extended from the Blue Sky AMS fonts using MetaType1) [16,15].

2. When on screen, the fonts are usually anti-aliased, often into a gray blur because the stems are not thick enough to fill a pixel. When printed with a high-resolution laser printer, the fonts are shown accurately, but I think are too thin. With a medium-resolution printer like an inkjet, there's enough resolution to show the form of the letters (unlike on screen), but the low-resolution "bulks up" the letters compared to a high-resolution laser printer, with the letters thus appearing darker.

Figure 1: Computer Modern (using the Blue Sky and Y&Y Type 1 fonts; no package necessary).

Theorem 1 (Residue Theorem). Let f be analytic in the region G except for the isolated singularities $a_1, a_2, \ldots, a_m$. If γ is a closed rectifiable curve in G which does not pass through any of the points a_k and if $\gamma \approx 0$ in G then

$$\frac{1}{2\pi i}\int_\gamma f = \sum_{k=1}^{m} n(\gamma; a_k)\mathrm{Res}(f; a_k).$$

Theorem 2 (Maximum Modulus). *Let G be a bounded open set in $\mathbb{C}$ and suppose that f is a continuous function on G^- which is analytic in G. Then*

$$\max\{|f(z)| : z \in G^-\} = \max\{|f(z)| : z \in \partial G\}.$$

AΛΔ∇BCDΣEFΓGHIJKLMNOΘΩ℧PΦΠΞQRSTUVWXYϒΨZ 1234567890
$a\alpha b\beta c\partial d\delta e\epsilon\varepsilon f\zeta\xi g\gamma h\hbar\hbar i\imath j\jmath k\kappa\varkappa l\ell\lambda mn\eta\theta\vartheta o\sigma\varsigma\phi\varphi p\wp p\rho\varrho qrst\tau\pi u\mu\nu v\upsilon w\omega\varpi x\chi y\psi z \infty \propto \emptyset\varnothing \mathrm{d}\eth \ni$

The SliTEX font (`lcmss`) is a sans serif text face that has wide letters and high *x* height. Its high readability makes it extremely suitable for slide presentations. However, there is no matching math font. SliTEX sans serif can be set as the primary text font using TEXPower's `tpslifonts.sty` [17].

Computer Modern Bright: This a sans serif font with corresponding math font derived from Computer Modern by Walter A. Schmidt [18]. CM-Super contains Type 1 versions of the text fonts in T1 encoding, and Harald Harders created Type 1 versions of the text and math fonts called `hfbright` [19] using `mftrace`.

Concrete and Euler or Concrete Math: The Concrete font was created by Knuth for his book *Concrete Mathematics* [20]. Hermann Zapf was commissioned by the AMS to create the math font Euler for use in *Concrete Mathematics*. Type 1 versions of Concrete in T1 encoding are available in the CM-Super collection [13], and Type 1 versions of Euler are available in the Blue Sky collection from the AMS [8] and in the BaKoMa collection [9]. The `eulervm` package by Walter Schmidt [23, 24] implements virtual fonts for Euler that are more efficient to use with LATEX. Ulrik Vieth created the Concrete Math fonts [21] to match the Concrete text fonts;

Figure 2: CM Bright (\usepackage{cmbright}; output uses the hfbright fonts).

Theorem 1 (Residue Theorem). Let f be analytic in the region G except for the isolated singularities $a_1, a_2, \ldots, a_m$. If γ is a closed rectifiable curve in G which does not pass through any of the points a_k and if $\gamma \approx 0$ in G then

$$\frac{1}{2\pi i}\int_\gamma f = \sum_{k=1}^{m} n(\gamma; a_k)\mathrm{Res}(f; a_k).$$

Theorem 2 (Maximum Modulus). *Let G be a bounded open set in $\mathbb{C}$ and suppose that f is a continuous function on G^- which is analytic in G. Then*

$$\max\{|f(z)| : z \in G^-\} = \max\{|f(z)| : z \in \partial G\}.$$

AΛΔ∇BCDΣEFΓGHIJKLMNOΘΩϑPΦΠΞQRSTUVWXYϒΨZ 1234567890
$a\alpha b\beta c\partial d\delta e\epsilon\varepsilon f\zeta\xi g\gamma h\hbar\hbar\imath\imath j j k\kappa\varkappa l\ell\lambda m n\eta\theta\vartheta o\sigma\varsigma\phi\varphi\wp p p\varrho q r s t\tau\pi u\mu\nu\upsilon w\omega\varpi x\chi y\psi z \infty \propto \emptyset\varnothing \mathrm{d}\eth \ni$

the only free versions are implemented in METAFONT. The ccfonts package by Walter Schmidt [22] changes the text font to Concrete and changes the math font to the Concrete Math fonts if eulervm is not loaded.

Iwona and Kurier: The fonts Iwona and Kurier were created by J. M. Nowacki [25, 26] using the MetaType1 system based on typefaces by the Polish typographer Małgorzata Budyta. The two fonts are very similar, except that Kurier avoids "ink traps" with gaps in its strokes. The packages have complete math support in both TEX and LATEX.

Antykwa Półtawskiego: J. M. Nowacki created the font Antykwa Półtawskiego [27] using the MetaType1 system based on a typeface by Polish typographer Adam Półtawski. The package antpolt has no math support at this time, and requires the encoding to be set to QX or OT4.

Antykwa Toruńska: The font Antykwa Toruńska was created by J. M. Nowacki [29, 28] using the MetaType1 system based on a typeface by the Polish typographer Zygfryd Gardzielewski. The package anttor has complete math support in both TEX and LATEX.

Figure 3: Concrete text with Euler math (`\usepackage{ccfonts,eulervm}` `\usepackage[T1]{fontenc}`). Note that Concrete does not have a bold font, so Computer Modern is used instead. Non-bold text output uses the CM-Super Concrete fonts.

Theorem 1 (Residue Theorem). Let f be analytic in the region G except for the isolated singularities $a_1, a_2, \ldots, a_m$. If γ is a closed rectifiable curve in G which does not pass through any of the points a_k and if $\gamma \approx 0$ in G then

$$\frac{1}{2\pi i}\int_\gamma f = \sum_{k=1}^{m} n(\gamma; a_k)\mathrm{Res}(f; a_k).$$

Theorem 2 (Maximum Modulus). *Let G be a bounded open set in $\mathbb{C}$ and suppose that f is a continuous function on G^- which is analytic in G. Then*

$$\mathbf{max}\{|f(z)| : z \in G^-\} = \mathbf{max}\{|f(z)| : z \in \partial G\}.$$

ΑΛΔ∇ΒCDΣΕFΓGΗΙJΚLΜΝΟΘΩϑΡΦΠΞQRSΤUVWΧΥΥΨΖ 1234567890
αɑbβcϑdδeєεfζξgγhℏħιiȷjκкℵlℓλmnηθϑoσσφφϕpρρqrstτπuμννvwωϖxχyψz ∞ ∝ ∅∅dð ɜ

3 Core Postscript Fonts

When Adobe introduced Postscript in 1984, they defined 35 core fonts (in 10 typefaces) that must be present in all Postscript interpreters. In 1996, URW++ released a replacement set for the core fonts under the GNU General Public License. The URW++ fonts were primarily released for use with Ghostscript, a free Postscript interpreter. Table 1 lists the original Postscript fonts, along with the URW++/Ghostscript equivalents. Each font can be used as the default text font by selecting the indicated LaTeX package from the PSNFSS distribution [30].

Avant Garde and Kerkis Sans: The font Kerkis Sans was created by Antonis Tsolomitis [31,32] by extending Avant Garde to include Greek and additional Latin characters. The resulting fonts are stand-alone and can be used by applications outside of TeX. The package `kerkis` sets the sans serif font to Kerkis Sans; there is no package option to set Kerkis Sans to be the primary text font.

Figure 4: Concrete text with Concrete math (`\usepackage{ccfonts}` `\usepackage[T1]{fontenc}`). Note that Concrete does not have a bold font, so Computer Modern is used instead. Non-bold text output uses the CM-Super Concrete fonts.

Theorem 1 (Residue Theorem). Let f be analytic in the region G except for the isolated singularities $a_1, a_2, \ldots, a_m$. If γ is a closed rectifiable curve in G which does not pass through any of the points a_k and if $\gamma \approx 0$ in G then

$$\frac{1}{2\pi i}\int_\gamma f = \sum_{k=1}^{m} n(\gamma; a_k)\mathrm{Res}(f; a_k).$$

Theorem 2 (Maximum Modulus). *Let G be a bounded open set in $\mathbb{C}$ and suppose that f is a continuous function on G^- which is analytic in G. Then*

$$\max\{|f(z)| : z \in G^-\} = \max\{|f(z)| : z \in \partial G\}.$$

AΛΔ∇BCDΣEFΓGHIJKLMNOΘΩϑPΦΠΞQRSTUVWXYϒΨZ 1234567890
aαbβcϑdδeϵεfζξgγhℏħιijȷkκϰlℓλmnηθϑoσςϕφϱpϖρϱqrstτπuμνvυwωϖxχyψz ∞ ∝ ∅∅dð ɜ

Figure 5: Iwona text and math (`\usepackage[math]{iwona}`).

Theorem 1 (Residue Theorem). Let f be analytic in the region G except for the isolated singularities $a_1, a_2, \ldots, a_m$. If γ is a closed rectifiable curve in G which does not pass through any of the points a_k and if $\gamma \approx 0$ in G then

$$\frac{1}{2\pi i}\int_\gamma f = \sum_{k=1}^{m} n(\gamma; a_k)\mathrm{Res}(f; a_k).$$

Theorem 2 (Maximum Modulus). *Let G be a bounded open set in $\mathbb{C}$ and suppose that f is a continuous function on G^- which is analytic in G. Then*

$$\max\{|f(z)| : z \in G^-\} = \max\{|f(z)| : z \in 6G\}.$$

AΛΔ∇BCDΣEFΓGHIJKLMNOΘΩϑPΦΠΞQRSTUVWXYϒΨZ 1234567890
aαbβc6dδeϵεfζξgγhℏħιijkκϰlℓλmnηθϑoσςϕφϱpϖρϱqrstτπuμνvυwωϖxχyψz ∞ ∝ ∅∅dð ɜ

Figure 6: Kurier text and math (`\usepackage[math]{kurier}`).

Theorem 1 (Residue Theorem). Let f be analytic in the region G except for the isolated singularities $a_1, a_2, \ldots, a_m$. If γ is a closed rectifiable curve in G which does not pass through any of the points a_k and if $\gamma \approx 0$ in G then

$$\frac{1}{2\pi i}\int_\gamma f = \sum_{k=1}^{m} n(\gamma; a_k)\mathrm{Res}(f; a_k).$$

Theorem 2 (Maximum Modulus). *Let G be a bounded open set in $\mathbb{C}$ and suppose that f is a continuous function on G^- which is analytic in G. Then*

$$\max\{|f(z)| : z \in G^-\} = \max\{|f(z)| : z \in \partial G\}.$$

AΛΔ∇BCDΣEFΓGHIJKLMNOΘΩϑPΦΠΞQRSTUVWXYϒΨZ 1234567890
aαbβcðdδeϵεfζξgγhℏħıijkκϰlℓλmnηθϑoσςϕφϱpρϱqrstτπuμνvυwωϖxχyψz ∞ ∝ ∅∅dð ɜ

Figure 7: Antykwa Półtawskiego text (`\usepackage{antpolt}` and `\usepackage[QX]{fontenc}`).

Theorem 1 (Residue Theorem). Let f be analytic in the region G except for the isolated singularities $a_1, a_2, \ldots, a_m$. If γ is a closed rectifiable curve in G which does not pass through any of the points a_k and if $\gamma \approx 0$ in G then

$$\frac{1}{2\pi i}\int_\gamma f = \sum_{k=1}^{m} n(\gamma; a_k)\mathrm{Res}(f; a_k).$$

Theorem 2 (Maximum Modulus). *Let G be a bounded open set in $\mathbb{C}$ and suppose that f is a continuous function on G^- which is analytic in G. Then*

$$\max\{|f(z)| : z \in G^-\} = \max\{|f(z)| : z \in \partial G\}.$$

AΛΔ∇BCDΣEFΓGHIJKLMNOΘΩϑPΦΠΞQRSTUVWXYϒΨZ 1234567890
aαbβcðdδeϵεfζξgγhℏħıijȷkκϰlℓλmnηθϑoσςϕφϱpρϱqrstτπuμνvυwωϖxχyψz ∞ ∝ ∅∅dð ɜ

Figure 8: Antykwa Toruńska text and math (`\usepackage[math]{anttor}`).

Theorem 1 (Residue Theorem). Let f be analytic in the region G except for the isolated singularities $a_1, a_2, \ldots, a_m$. If γ is a closed rectifiable curve in G which does not pass through any of the points a_k and if $\gamma \approx 0$ in G then

$$\frac{1}{2\pi i}\int_\gamma f = \sum_{k=1}^{m} n(\gamma; a_k)\mathrm{Res}(f; a_k).$$

Theorem 2 (Maximum Modulus). *Let G be a bounded open set in $\mathbb{C}$ and suppose that f is a continuous function on G^- which is analytic in G. Then*

$$\max\{|f(z)| : z \in G^-\} = \max\{|f(z)| : z \in \partial G\}.$$

AΛΔ∇BCDΣEFΓGHIJKLMNOΘΩϑPΦΠΞQRSTUVWXYΥΨZ 1234567890
aαbβcϑdδeϵεfζξgγhℏħıijkκϰlℓλmnηθϑoσςϕφϱpρϱqrstτπuμvvvwωϖxχyψz ∞ ∝ ∅∅dð ɘ

Adobe Postscript	URW++/Ghostscript	# of fonts	package
Avant Garde	URW Gothic L	4	`avant`
Bookman	URW Bookman L	4	`bookman`
Courier	Nimbus Mono L	4	`courier`
Helvetica	Nimbus Sans L	8	`helvet`
New Century Schoolbook	Century Schoolbook L	4	`newcent`
Palatino	URW Palladio L	4	`palatino`
Symbol	Standard Symbols L	1	—
Times	Nimbus Roman No. 9 L	4	`times`
Zapf Chancery	URW Chancery L	1	`chancery`
Zapf Dingbats	Dingbats	1	—

Table 1: Core Postscript fonts and URW++/Ghostscript equivalents.

Figure 9: Kerkis text and math (`\usepackage{kmath,kerkis}`; the order of the packages matters, since `kmath` loads the `txfonts` package which changes the default text font).

Theorem 1 (Residue Theorem). Let f be analytic in the region G except for the isolated singularities $a_1, a_2, \ldots, a_m$. If γ is a closed rectifiable curve in G which does not pass through any of the points a_k and if $\gamma \approx 0$ in G then

$$\frac{1}{2\pi i}\int_\gamma f = \sum_{k=1}^{m} n(\gamma; a_k)\operatorname{Res}(f; a_k).$$

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$$\max\{|f(z)| : z \in G^-\} = \max\{|f(z)| : z \in \partial G\}.$$

AΛΔ∇BCDΣEFΓGHIJKLMNOΘΩ℧PΦΠΞQRSTUVWXYϒΨZ 1234567890
aαbβcðdδeϵεfζξgγhħℏιiȷjkκϰlℓ⅄mnηð϶oσςφϕ℘pρϱqrstτπuμνυvwωϖxχyψz ∞ ∝ ∅∅dð ϶

Bookman and Kerkis: The font Kerkis was created by Antonis Tsolomitis [31, 32] by extending URW Bookman L to include Greek and additional Latin characters. The resulting fonts are stand-alone and can be used by applications outside of TEX. A font of math symbols is included, but not used by the LATEX package. The package `kmath` uses txfonts for math symbols and uppercase Greek letters.

New Century Schoolbook and Millennial or fouriernc: The Millennial math font of the current author contains Greek letters and other letter-like mathematical symbols. A set of virtual fonts is provided that uses New Century Schoolbook for Latin letters in math, Millennial for Greek and other letter-like symbols, and txfonts and Computer Modern for all other symbols, including binary operators, relations, and large symbols. This font is still in development, but will hopefully be released in 2006. The `fouriernc` package of Michael Zedler [33] uses New Century Schoolbook for text and Latin letters in mathematics, and the Greek and symbol fonts from the Fourier-GUTenberg package for the remaining mathematical symbols.

Figure 10: New Century Schoolbook with Millennial math
(\usepackage{millennial}).

Theorem 1 (Residue Theorem). Let f be analytic in the region G except for the isolated singularities $a_1, a_2, \ldots, a_m$. If γ is a closed rectifiable curve in G which does not pass through any of the points a_k and if $\gamma \approx 0$ in G then

$$\frac{1}{2\pi i}\int_\gamma f = \sum_{k=1}^{m} n(\gamma; a_k)\mathrm{Res}(f; a_k).$$

Theorem 2 (Maximum Modulus). *Let G be a bounded open set in $\mathbb{C}$ and suppose that f is a continuous function on G^- which is analytic in G. Then*

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AΛΔ∇BCDΣEFΓGHIJKLMNOΘΩ℧PΦΠΞQRSTUVWXYϒΨZ 1234567890
$a\alpha b\beta c\partial d\delta e\epsilon\varepsilon f\zeta\xi g\gamma h\hbar\hbar\imath\imath j\jmath k\kappa\varkappa l\ell\lambda m n\eta\theta\vartheta o\sigma\varsigma\phi\varphi\wp p\rho\varrho q r s t\tau\pi u\mu v\upsilon w\omega\varpi x\chi y\psi z \infty \propto \varnothing \mathrm{d}\eth \ni$

Figure 11: New Century Schoolbook with Fourier math
(\usepackage{fouriernc}).

Theorem 1 (Residue Theorem). Let f be analytic in the region G except for the isolated singularities $a_1, a_2, \ldots, a_m$. If γ is a closed rectifiable curve in G which does not pass through any of the points a_k and if $\gamma \approx 0$ in G then

$$\frac{1}{2\pi i}\int_\gamma f = \sum_{k=1}^{m} n(\gamma; a_k)\mathrm{Res}(f; a_k).$$

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$$\max\{|f(z)| : z \in G^-\} = \max\{|f(z)| : z \in \partial G\}.$$

AΛΔ∇BCDΣEFΓGHIJKLMNOΘΩ℧PΦΠΞQRSTUVWXYϒΨZ 1234567890
$a\alpha b\beta c\partial d\delta e\epsilon\varepsilon f\zeta\xi g\gamma h\hbar\hbar\imath\imath j\jmath k\kappa\varkappa l\ell\lambda m n\eta\theta\vartheta o\sigma\varsigma\phi\varphi\wp p\rho\varrho q r s t\tau\pi u\mu v\upsilon w\omega\varpi x\chi y\psi z \infty \propto \varnothing \mathrm{d}\eth \ni$

Figure 12: Palatino text with pxfonts math (`\usepackage{pxfonts}`).

Theorem 1 (Residue Theorem). Let f be analytic in the region G except for the isolated singularities $a_1, a_2, \ldots, a_m$. If γ is a closed rectifiable curve in G which does not pass through any of the points a_k and if $\gamma \approx 0$ in G then

$$\frac{1}{2\pi i}\int_\gamma f = \sum_{k=1}^{m} n(\gamma; a_k)\mathrm{Res}(f; a_k).$$

Theorem 2 (Maximum Modulus). *Let G be a bounded open set in $\mathbb{C}$ and suppose that f is a continuous function on G^- which is analytic in G. Then*

$$\max\{|f(z)| : z \in G^-\} = \max\{|f(z)| : z \in \partial G\}.$$

AΛΔ∇BCDΣEFΓGHIJKLMNOΘΩ℧PΦΠΞQRSTUVWXYϒΨZ 1234567890
aαbβcϑdδeϵεfζξgγhℏħıijjkκϰlℓλmnηθϑoσςϕφϱpprϱqrstτπuμνvvwωϖxχyψz ∞ ∝ ∅∅dð ɜ

Palatino and pxfonts, Pazo, or mathpple: Young Ryu created the pxfonts collection [34], which contains Greek and other letter-like symbols, as well as a complete set of geometric symbols, including the AMS symbols. Diego Puga created the Pazo math fonts, which include the Greek letters and other letter-like symbols in a style that matches Palatino. The LaTeX package `mathpazo` (now part of PSNFSS [30]) uses Palatino for Latin letters, Pazo for Greek and other letter-like symbols, and Computer Modern for geometric symbols. The LaTeX package `mathpple` (also part of PSNFSS [30]) uses Palatino for Latin letters and slanted Euler for Greek and other symbols. Since Hermann Zapf designed both Palatino and Euler, the designs mesh well. An alternate use of Euler is using the `eulervm` package. Ralf Stubner added small caps and old-style figures to URW Palladio L in the FPL package [36], and Walter Schmidt extended these fonts in the FPL Neu package [37].

Times and txfonts, Belleek, mathptmx, or mbtimes: Young Ryu created the txfonts collection [38], which contains Greek and other letter-like symbols, as well as a complete set of geometric symbols, including the AMS symbols. The `txfonts` package also includes a very nice typewriter font, `txtt`. Belleek was created by Richard Kinch [39, 40] and is a drop-in replacement for the commercial fonts required by the `mathtime` package (now part of PSNFSS [30]). The LaTeX package

Figure 13: Palatino text with Pazo math (\usepackage{mathpazo}).

Theorem 1 (Residue Theorem). Let f be analytic in the region G except for the isolated singularities $a_1, a_2, \ldots, a_m$. If γ is a closed rectifiable curve in G which does not pass through any of the points a_k and if $\gamma \approx 0$ in G then

$$\frac{1}{2\pi i} \int_\gamma f = \sum_{k=1}^{m} n(\gamma; a_k) \mathrm{Res}(f; a_k).$$

Theorem 2 (Maximum Modulus). *Let G be a bounded open set in $\mathbb{C}$ and suppose that f is a continuous function on G^- which is analytic in G. Then*

$$\max\{|f(z)| : z \in G^-\} = \max\{|f(z)| : z \in \partial G\}.$$

AΛΔ∇BCDΣEFΓGHIJKLMNOΘΩ℧PΦΠΞQRSTUVWXYYΨZ 1234567890
aαbβc∂dδeϵεfζξgγhℏℏiıȷjkκϰlℓλmnηθϑoσςϕφ℘pρϱqrstτπuμνvυwωϖxχyψz ∞ ∝ ∅⌀dð ∍

Figure 14: Palatino text with Euler math (\usepackage{mathpple}).

Theorem 1 (Residue Theorem). Let f be analytic in the region G except for the isolated singularities $a_1, a_2, \ldots, a_m$. If γ is a closed rectifiable curve in G which does not pass through any of the points a_k and if $\gamma \approx 0$ in G then

$$\frac{1}{2\pi i} \int_\gamma f = \sum_{k=1}^{m} n(\gamma; a_k) \mathrm{Res}(f; a_k).$$

Theorem 2 (Maximum Modulus). *Let G be a bounded open set in $\mathbb{C}$ and suppose that f is a continuous function on G^- which is analytic in G. Then*

$$\max\{|f(z)| : z \in G^-\} = \max\{|f(z)| : z \in \partial G\}.$$

AΛΔ∇BCDΣEFΓGHIJKLMNOΘΩ℧PΦΠΞQRSTUVWXYϒΨZ 1234567890
aαbβc∂dδeϵεfζξgγhℏℏiıȷȷkκϰlℓλmnηθϑoσσϕφ℘pρρqrstτπuμνvυwωϖxχyψz ∞ ∝ ∅⌀dð ∍

Figure 15: Times text with txfonts math (`\usepackage[varg]{txfonts}`).

Theorem 1 (Residue Theorem). Let f be analytic in the region G except for the isolated singularities $a_1, a_2, \ldots, a_m$. If γ is a closed rectifiable curve in G which does not pass through any of the points a_k and if $\gamma \approx 0$ in G then

$$\frac{1}{2\pi i}\int_\gamma f = \sum_{k=1}^{m} n(\gamma; a_k)\mathrm{Res}(f; a_k).$$

Theorem 2 (Maximum Modulus). *Let G be a bounded open set in $\mathbb{C}$ and suppose that f is a continuous function on G^- which is analytic in G. Then*

$$\max\{|f(z)| : z \in G^-\} = \max\{|f(z)| : z \in \partial G\}.$$

AΛΔ∇BCDΣEFΓGHIJKLMNOΘΩϑPΦΠΞQRSTUVWXYϒΨZ 1234567890
aαbβcðdδeϵεfζξgγhℏħiıjȷkκlℓλmnηθϑoσςϕφϱpρϱqrstτπuμνυωϖxχyψz ∞ ∝ ∅∅dð ə

`mathptmx` (also part of PSNFSS [30]) uses Times for Latin letters and Symbol for Greek and other symbols. Michel Bovani created the `mbtimes` package by using Omega Serif for text and Latin and Greek letters in mathematics. `mbtimes` also includes symbol fonts and a set of calligraphic letters. Omega Serif is the primary font for Omega, a 16-bit extension of TEX by John Plaice and Yannis Haralambous [43].

The STIX fonts project [41] is a collaboration of several academic publishers to create a set of Times-compatible fonts containing every possible glyph needed for mathematical and technical publishing. These fonts are still in development, with a scheduled release in the middle of 2006.

Note that Adobe Reader 7.0 replaces Times with Adobe Serif MM if Times or the Ghostscript equivalent Nimbus Roman No. 9 L is not embedded in the PDF file. Adobe Serif MM only has an oblique version, not a real italics, and thus, the primary text and Latin letters in mathematics will not match letters taken from additional fonts. This problem can be avoided by embedding Times or the Ghostscript equivalent Nimbus Roman No. 9 L into the PDF file. Also, I have heard (but not personally verified) that the Windows version of Adobe Reader displays Times New Roman when Times is not embedded. The upright versions of the two typefaces are very similar, but the italics are noticeably different (consider the z, for instance).

Figure 16: Times text with Belleek math (`\usepackage{mathtime}`; output uses the Belleek fonts).

Theorem 1 (Residue Theorem). Let f be analytic in the region G except for the isolated singularities $a_1, a_2, \ldots, a_m$. If γ is a closed rectifiable curve in G which does not pass through any of the points a_k and if $\gamma \approx 0$ in G then

$$\frac{1}{2\pi i}\int_\gamma f = \sum_{k=1}^{m} n(\gamma\,;a_k)\mathrm{Res}(f;a_k).$$

Theorem 2 (Maximum Modulus). *Let G be a bounded open set in $\mathbb{C}$ and suppose that f is a continuous function on G^- which is analytic in G. Then*

$$\max\{|f(z)| : z \in G^-\} = \max\{|f(z)| : z \in \partial G\}.$$

AΛΔ∇BCDΣEFΓGHIJKLMNOΘΩϑPΦΠΞQRSTUVWXYϒΨZ 1234567890
$a\alpha b\beta c\partial d\delta e\epsilon\varepsilon f\zeta\xi g\gamma h\hbar\hbar\imath i\jmath j k\kappa\varkappa l\ell\lambda mn\eta\theta\vartheta o\sigma\varsigma\phi\varphi\wp p\rho\varrho qrst\tau\pi u\mu\nu\upsilon v\omega\varpi x\chi y\psi z \infty \propto \emptyset\varnothing\mathrm{d}\eth\ \ni$

Figure 17: Times text with Symbol math (`\usepackage{mathptmx}`).

Theorem 1 (Residue Theorem). Let f be analytic in the region G except for the isolated singularities $a_1, a_2, \ldots, a_m$. If γ is a closed rectifiable curve in G which does not pass through any of the points a_k and if $\gamma \approx 0$ in G then

$$\frac{1}{2\pi i}\int_\gamma f = \sum_{k=1}^{m} n(\gamma;a_k)\mathrm{Res}(f;a_k).$$

Theorem 2 (Maximum Modulus). *Let G be a bounded open set in $\mathbb{C}$ and suppose that f is a continuous function on G^- which is analytic in G. Then*

$$\max\{|f(z)| : z \in G^-\} = \max\{|f(z)| : z \in \partial G\}.$$

AΛΔ∇BCDΣEFΓGHIJKLMNOΘΩϑPΦΠΞQRSTUVWXYϒΨZ 1234567890
$a\alpha b\beta c\partial d\delta e\varepsilon\varepsilon f\zeta\xi g\gamma h\hbar\hbar\imath i\jmath j k\kappa\varkappa l\ell\lambda mn\eta\theta\vartheta o\sigma\varsigma\phi\varphi\wp p\rho\varrho qrst\tau\pi u\mu\nu\upsilon v\omega\varpi x\chi y\psi z \infty \propto \emptyset\varnothing\mathrm{d}\eth\ \ni$

Figure 18: Omega Serif text with Omega math (`\usepackage{mbtimes}`).

Theorem 1 (Residue Theorem). Let f be analytic in the region G except for the isolated singularities $a_1, a_2, \ldots, a_m$. If γ is a closed rectifiable curve in G which does not pass through any of the points a_k and if $\gamma \approx 0$ in G then

$$\frac{1}{2\pi i}\int_\gamma f = \sum_{k=1}^{m} n(\gamma; a_k)\mathrm{Res}(f; a_k).$$

Theorem 2 (Maximum Modulus). *Let G be a bounded open set in $\mathbb{C}$ and suppose that f is a continuous function on G^- which is analytic in G. Then*

$$\max\{|f(z)| : z \in G^-\} = \max\{|f(z)| : z \in \partial G\}.$$

ΑΛΔ∇ΒCDΣΕFΓGΗΙJΚLΜΝΟΘΩ℧ΡΦΠΞQRSTUVWXYϒΨΖ 1234567890
$a\alpha b\beta c\eth d\delta e\epsilon\varepsilon f\zeta\xi g\gamma h\hbar\hbar i\imath j\jmath k\varkappa\kappa l\ell\lambda m n\eta\theta\vartheta o\sigma\varsigma\phi\varphi\wp p\rho\varrho q r s t\tau\pi u\mu v\varv w\omega\varpi x\chi y\psi z \infty \propto \emptyset\varnothing \mathrm{d}\eth \ni$

Helvetica, Courier, and Zapf Chancery do not have matching math fonts. Courier and Zapf Chancery are inappropriate for mathematics anyway, but Helvetica is sometimes used for presentations and posters. The free fonts MgOpenModerna [44] and FreeSans [45] would be natural choices for the Greek letters in a Helvetica mathematics font.

4 Other Free Fonts

Several other fonts have been released for use with free open-source software. LaTeX packages have been created for most of these fonts.

Bitstream Vera Sans and Arev Sans: Bitstream Vera was released by Bitstream in cooperation with the Gnome Foundation [46] as a high quality scalable free font for use with free open-source software. Bitstream Vera serif, sans serif, and sans mono are available in text using the `bera` package by Malte Rosenau and Walter A. Schmidt [47]. Tavmjong Bah created Arev Sans [49] by extending Bitstream Vera Sans to include Greek, Cyrillic, and many mathematical symbols. The current author created the LaTeX package `arev` [48] using Arev Sans for text and math letters and bold Math Design fonts for Bitstream Charter for symbols.

Figure 19: Arev Sans text with Arev math (`\usepackage{arev}`).

Theorem 1 (Residue Theorem). Let f be analytic in the region G except for the isolated singularities $a_1, a_2, \ldots, a_m$. If γ is a closed rectifiable curve in G which does not pass through any of the points a_k and if $\gamma \approx 0$ in G then

$$\frac{1}{2\pi i}\int_\gamma f = \sum_{k=1}^{m} n(\gamma; a_k)\mathrm{Res}(f; a_k).$$

Theorem 2 (Maximum Modulus). *Let G be a bounded open set in $\mathbb{C}$ and suppose that f is a continuous function on G^- which is analytic in G. Then*

$$\max\{|f(z)| : z \in G^-\} = \max\{|f(z)| : z \in \partial G\}.$$

AΛΔ∇BCDΣEFΓGHIJKLMNOΘΩʊPΦΠΞQRSTUVWXYϒΨZ 1234567890
aɑbβcɔdδeɛɛfζξgγhħℏiıjjkκϰlℓλmnηθϑoσςϕφℊpprϱqrstτπuμννυwωϖxχyψz
∞ ∝ ∅∅dð ə

Bitstream Charter and Math Design: Bitstream Charter [50] was donated by Bitstream for use with X Windows. The Math Design fonts for Bitstream Charter created by Paul Pichaureau [51] are very complete, including Greek letters, symbols from Computer Modern, and the AMS symbols. Charis SIL [52] might be an alternate source for Greek letters that match Bitstream Charter more closely. Another possibility for a math font is to use the Euler fonts with the `charter` and `eulervm` packages.

URW Garamond and Math Design: URW Garamond No. 8 [53] is available under the Aladdin Free Public License as part of the GhostPCL project. The Math Design fonts for URW Garamond created by Paul Pichaureau [51] are very complete, including Greek letters, symbols from Computer Modern, and the AMS symbols.

Utopia and Fourier or Math Design: Utopia [54] was donated by Adobe for use with X Windows. Michel Bovani created Fourier-GUTenberg [55] as an accompaniment to Utopia and is very complete, containing both Greek letters and standard and AMS symbols. The Math Design fonts for Utopia of Paul Pichaureau [51] are also very complete, including Greek letters and AMS symbols.

Figure 20: Bitstream Charter text with Math Design math
(`\usepackage[charter]{mathdesign}`).

Theorem 1 (Residue Theorem). Let f be analytic in the region G except for the isolated singularities $a_1, a_2, \ldots, a_m$. If γ is a closed rectifiable curve in G which does not pass through any of the points a_k and if $\gamma \approx 0$ in G then

$$\frac{1}{2\pi i}\int_\gamma f = \sum_{k=1}^{m} n(\gamma; a_k)\mathrm{Res}(f; a_k).$$

Theorem 2 (Maximum Modulus). *Let G be a bounded open set in $\mathbb{C}$ and suppose that f is a continuous function on G^- which is analytic in G. Then*

$$\max\{|f(z)| : z \in G^-\} = \max\{|f(z)| : z \in \partial G\}.$$

AΛΔ∇BCDΣEFΓGHIJKLMNOΘΩ℧PΦΠΞQRSTUVWXYϒΨZ 1234567890
$a\alpha b\beta c\partial d\delta e\epsilon\varepsilon f\zeta\xi g\gamma h\hbar\hbar\imath\imath j\jmath k\kappa\varkappa l\ell\lambda mn\eta\theta\vartheta o\sigma\varsigma\phi\varphi\wp p\rho\varrho qrst\tau\pi u\mu v\nu v\upsilon w\omega\varpi x\chi y\psi z \infty \propto \emptyset\varnothing \mathrm{d}\eth \ni$

Figure 21: URW Garamond text with Math Design math
(`\usepackage[garamond]{mathdesign}`).

Theorem 1 (Residue Theorem). Let f be analytic in the region G except for the isolated singularities $a_1, a_2, \ldots, a_m$. If γ is a closed rectifiable curve in G which does not pass through any of the points a_k and if $\gamma \approx 0$ in G then

$$\frac{1}{2\pi i}\int_\gamma f = \sum_{k=1}^{m} n(\gamma; a_k)\mathrm{Res}(f; a_k).$$

Theorem 2 (Maximum Modulus). *Let G be a bounded open set in $\mathbb{C}$ and suppose that f is a continuous function on G^- which is analytic in G. Then*

$$\max\{|f(z)| : z \in G^-\} = \max\{|f(z)| : z \in \partial G\}.$$

AΛΔ∇BCDΣEFΓGHIJKLMNOΘΩ℧PΦΠΞQRSTUVWXYϒΨZ 1234567890
$a\alpha b\beta c\partial d\delta e\epsilon\varepsilon f\zeta\xi g\gamma h\hbar\hbar\imath\imath j\jmath k\varkappa\kappa l\ell\lambda mn\eta\theta\vartheta o\sigma\varsigma\phi\varphi\wp p\rho\varrho qrst\tau\pi u\mu v\nu v\upsilon w\omega\varpi x\chi y\psi z$
$\infty \propto \emptyset\varnothing \mathrm{d}\eth \ni$

Figure 22: Utopia text with Fourier-GUTenberg math (`\usepackage{fourier}`).

Theorem 1 (Residue Theorem). Let f be analytic in the region G except for the isolated singularities $a_1, a_2, \ldots, a_m$. If γ is a closed rectifiable curve in G which does not pass through any of the points a_k and if $\gamma \approx 0$ in G then

$$\frac{1}{2\pi i}\int_\gamma f = \sum_{k=1}^{m} n(\gamma; a_k)\mathrm{Res}(f; a_k).$$

Theorem 2 (Maximum Modulus). *Let G be a bounded open set in $\mathbb{C}$ and suppose that f is a continuous function on G^- which is analytic in G. Then*

$$\max\{|f(z)| : z \in G^-\} = \max\{|f(z)| : z \in \partial G\}.$$

AΛΔ∇BCDΣEFΓGHIJKLMNOΘΩ℧PΦΠΞQRSTUVWXYϒΨZ 1234567890
$a\alpha b\beta c\partial d\delta e\epsilon\varepsilon f\zeta\xi g\gamma h\hbar\hbar\imath\imath j\jmath k\kappa\varkappa l\ell\lambda m n\eta\theta\vartheta o\sigma\varsigma\phi\varphi\wp p\rho\varrho q r s t\tau\pi u\mu\nu v\upsilon w\omega\varpi x\chi y\psi z \infty\propto \emptyset\varnothing \mathrm{d}\eth \ni$

Figure 23: Utopia text with Math Design math
(`\usepackage[utopia]{mathdesign}`).

Theorem 1 (Residue Theorem). Let f be analytic in the region G except for the isolated singularities $a_1, a_2, \ldots, a_m$. If γ is a closed rectifiable curve in G which does not pass through any of the points a_k and if $\gamma \approx 0$ in G then

$$\frac{1}{2\pi i}\int_\gamma f = \sum_{k=1}^{m} n(\gamma; a_k)\mathrm{Res}(f; a_k).$$

Theorem 2 (Maximum Modulus). *Let G be a bounded open set in $\mathbb{C}$ and suppose that f is a continuous function on G^- which is analytic in G. Then*

$$\max\{|f(z)| : z \in G^-\} = \max\{|f(z)| : z \in \partial G\}.$$

AΛΔ∇BCDΣEFΓGHIJKLMNOΘΩ℧PΦΠΞQRSTUVWXYϒΨZ 1234567890
$a\alpha b\beta c\partial d\delta e\epsilon\varepsilon f\zeta\xi g\gamma h\hbar\hbar\imath\imath j\jmath k\kappa\varkappa l\ell\lambda m n\eta\theta\vartheta o\sigma\varsigma\phi\varphi\wp p\rho\varrho q r s t\tau\pi u\mu\nu v\upsilon w\omega\varpi x\chi y\psi z$
$\infty\propto\emptyset\varnothing\mathrm{d}\eth\ni$

Using METAFONT, Achim Blumensath created the package `MnSymbol` [56], which contains geometric symbols (no Greek or other letter-like symbols) in varying optical sizes that match the commercial font Adobe MinionPro. The `MnSymbol` package also contains traced Type 1 versions. `MnSymbol` is free; however the package `MinionPro` of Achim Blumensath, Andreas Bühmann, and Michael Zedler [57] which uses `MnSymbol` requires a license from Adobe for the font MininonPro.

5 Comparison of Features

Table 2 shows a comparison of the different features in each package. The only packages that have optical sizes are Computer Modern, CM Bright, Concrete, Euler, and MnSymbol. Except for when the `eulervm` package is used, Latin math letters are taken from the italic text font. An asterisk after a font name indicates that the package has a version of that style in its own font files.

The only sans serif fonts with matching math fonts are CM Bright and Arev Sans. Both work well for presentations. Computer Modern sans serif, CM Bright, Arev Sans, Bera Sans, Kerkis Sans, Helvetica, and Avant Garde all work well as sans serif fonts that accompany a primary roman font. Computer Modern typewriter, `txtt` (from txfonts), Luxi Mono [59], and Bera Mono all work well as typewriters fonts.

There are several other free fonts easily used in LaTeX, notably the Bera fonts, Luxi Mono, and efont-serif [60]. Malte Rosenau converted the Bitstream Vera fonts into Type 1 format, renaming the fonts to Bera [47]. Bera includes serif, sans, and mono. Bera Serif does not have a matching italic font, but the DejaVu fonts [58] are an extension of Bitstream Vera that include a true serif italic, as well as Greek and Cyrillic for all three styles. Except for Bera Sans and Arev Sans, none of the previous fonts have matching math fonts.

6 Creation of this Survey

It might be technically feasible to create a font survey such as this article as a single TeX document. This document, however, was not created in that fashion for two reasons. First, it would be an inordinate amount of work to switch between fonts within the same document. The authors of the LaTeX packages put in a

Package	Text	Greek	CM sym	AMS sym	Calligr	Blkbd	boldmath
computer modern	cm	cm	cm	ams	cm	ams	yes
cmbright	cmbright	cmbright	cm*	cm*	cm*	ams	no
ccfonts,eulervm	concrete	euler	euler	ams	euler	ams	yes
concmath	concrete	concrete	concmath	concmath	concmath	concmath	no
iwona	iwona	iwona	iwona	iwona	cm*	ams	yes
kurier	kurier	kurier	kurier	kurier	cm*	ams	yes
anttor	anttor	anttor	anttor	anttor	anttor	ams	yes
kmath,kerkis	kerkis	kerkis	txfonts	txfonts	txfonts	txfonts	yes
millennial	nc schlbk	millennial	txfonts	txfonts	txfonts	ams	no
fouriernc	nc schlbk	fourier	fourier	fourier	fourier	fourier	yes
pxfonts	palatino	pxfonts	txfonts*	txfonts*	txfonts*	pxfonts	yes
mathpazo	palatino	pazo	cm	ams	cm	pazo	yes
mathpple	palatino	euler	euler	ams	cm	ams	yes
txfonts	times	txfonts	txfonts	txfonts	txfonts	txfonts	yes
mathtime (Belleek)	times	belleek	belleek	ams	cm	ams	no
mathptmx	times	symbol	cm	ams	rsfs	ams	no
mbtimes	omega	omega	mbtimes	ams	rsfs*	esstix	yes
mathdesign (Charter)	charter	md charter	md charter	md charter	rsfs*	ams	yes
arev	arev	arev	md charter	md charter	cm	fourier	yes
mathdesign (Garamond)	garamond	md garamond	md garamond	md garamond	rsfs*	ams*	yes
fourier	utopia	fourier	fourier	fourier	fourier	fourier	yes
mathdesign (Utopia)	utopia	md garamond	md utopia	md utopia	rsfs*	ams*	yes

Table 2: Comparison of the features of different packages.

```
\documentclass{article}
\include{sampleformat}
  \usepackage{fourier}
\begin{document}
  \include{textfragment}
\end{document}
```

Figure 24: Sample LaTeX file for `fourier`. The file `sampleformat.tex` contains page layout commands, such as setting the margins and removing the page numbers. The file `textfragment.tex` contains the text and mathematics fragment to be displayed. Both included files are used by every sample LaTeX file. The line "`\usepackage{fourier}`" was changed for each sample to the package listed in the sample's caption.

considerable amount of effort to set up the fonts for a document, and it would be silly to duplicate their work. Second, we want to show to a reader exactly what he or she will get by using that package.

In order to accomplish these goals, a small LaTeX file (see Figure 24 for an example) was made for each font that loaded the appropriate packages and then loaded a common text fragment for display. Each file was LaTeXed and then converted to an EPS file using `dvips` with the -E option. The -E option creates a tight bounding box around the text. The main file `survey.tex` then included each of these graphics, and was compiled with `pdflatex`. For some reason, `dvips` created an unusable one-page PS file when including `mbtimes.eps`. HeVeA was used to convert `survey.tex` directly to HTML.

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